CECOM Research Development and Engineering Center (CERDEC)
Space & Terrestrial Communications Directorate

Army Communications Science & Technology for the Objective Force

Armaments for the Army Transformation
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Mr. Antonio Fiuza
(732)427-2218 / Fax: (732)427-2822
Antonia.Fiuza@mail1.monmouth.army.mil

CECOM Bottom Line: THE SOLDIER

Communications & Networking Development Philosophy

Adopt Commercial off the shelf Technology

Adopt

Commercial Example

- **Personal Communications Services (PCS)**

Adapt Commercial Technology When It Cannot Be Directly Inserted

Adapt

- **PCS**
  - ✓ **Add Security**
  - ✓ **Downsize Base Station**

Develop Technology in Concert With Other Services and Agencies for Unique Areas

And Partnerships, Alliances, Teaming

Develop

- **PCS**
  - ✓ **Universal Handset**

Need to Differentiate Technology vs Product

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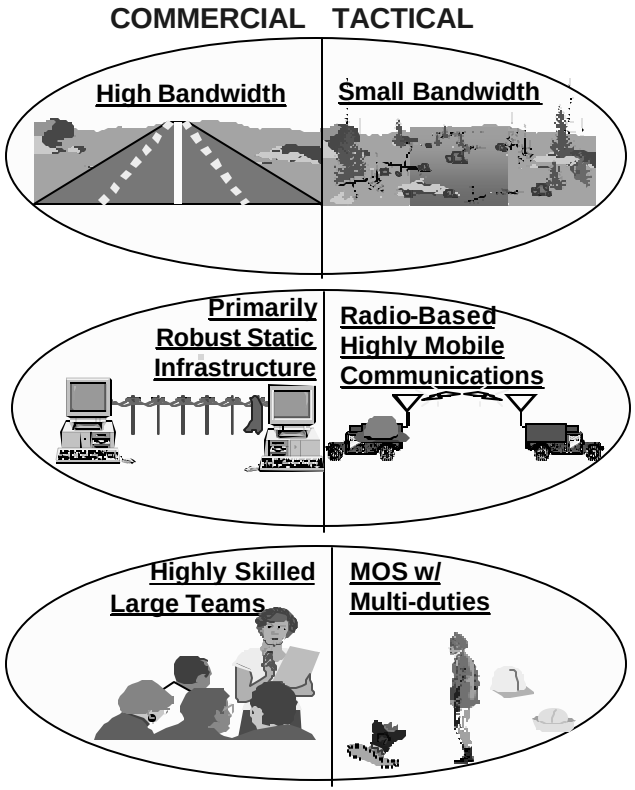
Commercial versus Military Communications Challenges

Commercial

- Mobile Subscriber, Fixed Infrastructure
- Pre-configured Networks
- Tall, Fixed Antenna Towers
- Fiberoptic Internodal Connections
- Greater Frequency Spectrum Availability
- Fixed Frequency Assignments
- Protection: None -> Privacy (single level)
- Interference Rejection is Somewhat Important
- Low probability of Detection (LPD) is not an issue



Military

- Mobile Subscriber - Mobile Infrastructure
- Ad Hoc, Self Organizing Networks
- Small, Easily Erectable Masts; Low Profile OTM Antennas
- Mobile, Wireless, Internodal Connections
- Restricted Frequency Assignments; Geographically Impacted
- Protection: None -> Top Secret/SI (Multiple, Simultaneous Levels)
- Interference Rejection and Antijam are Critical
- Low Probability of Detection (LPD) is Critical

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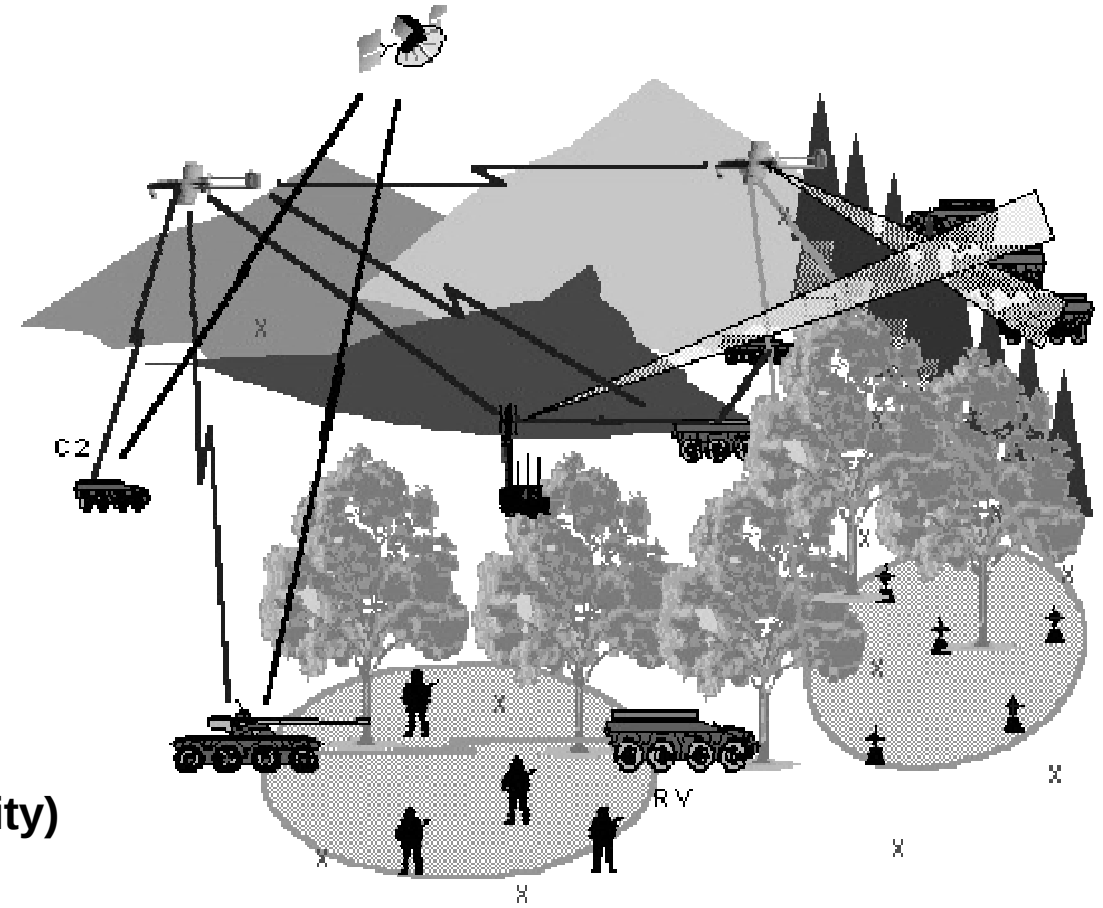
Communications Technology Challenges

Objective Force demands an assured, mobile, networked infrastructure that works in diverse complex terrain

- **Self-Organizing Networks**
- **High data rates**
- **Greater ranges/dispersion**
- **Real-time delivery**
- **Low-probability of detection**
- **Jam resistance**
- **Propagation effects**
  - **Terrain blockage**
  - **Foliage penetration**
  - **Urban “canyons”**
- **Context based routing (priority)**
- **Network Protection**



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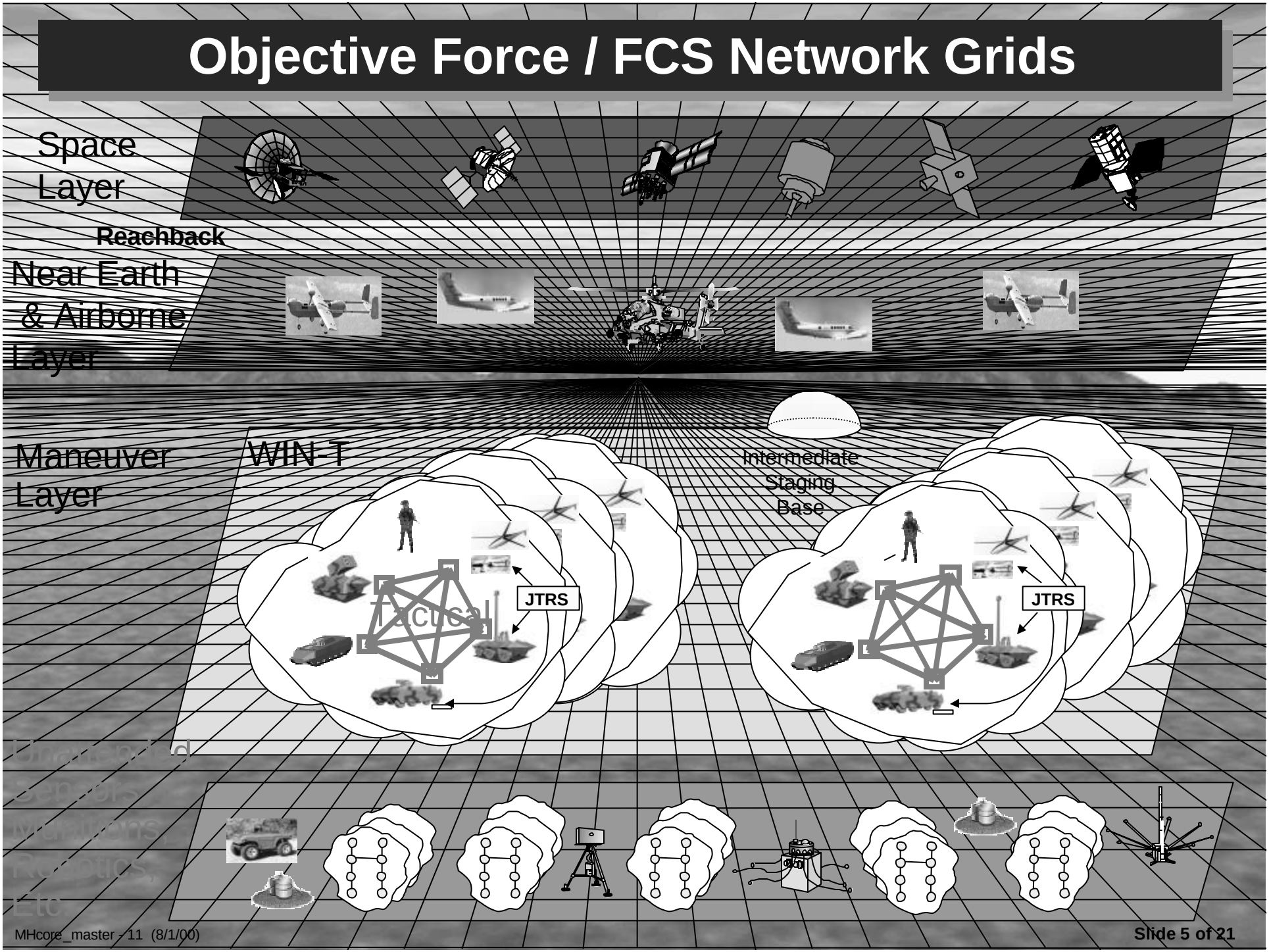
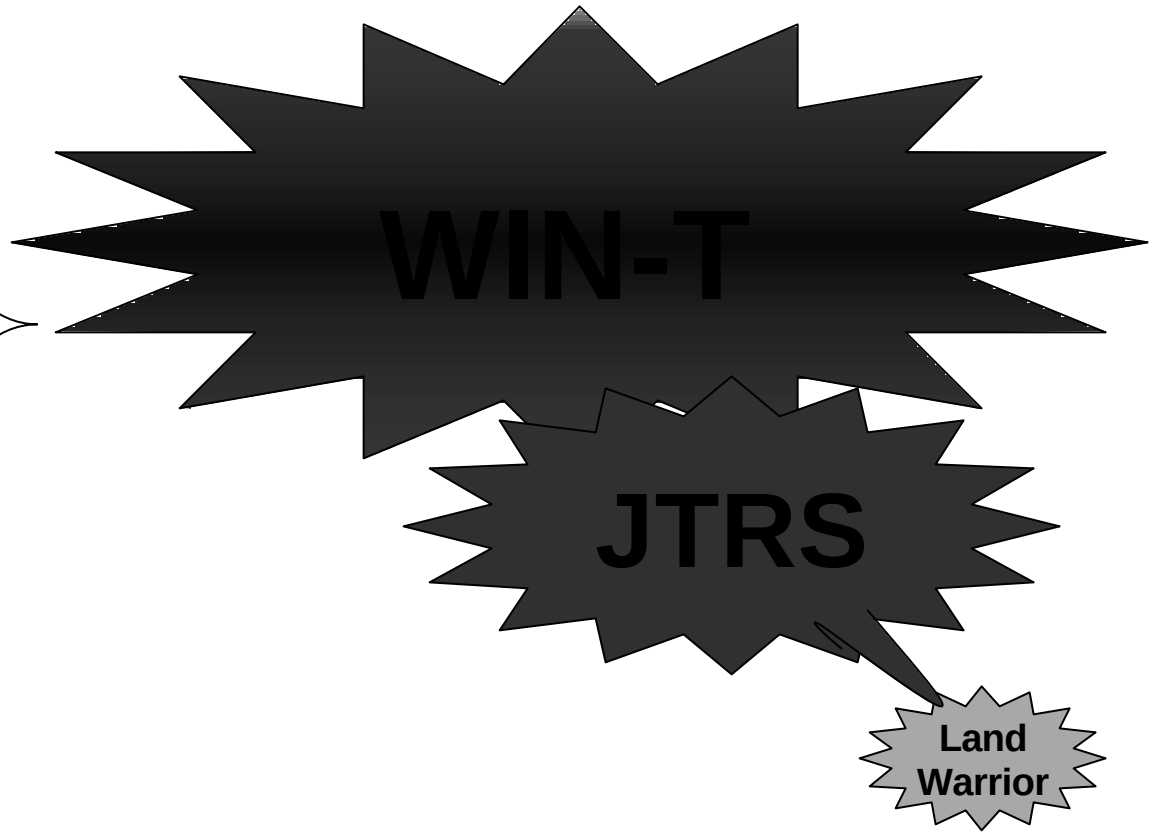
Objective Force / FCS Network Grids



Major Communication Thrusts

- **Secure On-the-Move Networking**
- **Reachback/Range Extension (SATCOM & UAV)**
- **Unattended Sensors Networking**
- **Secure Personal Communications**
- **Antennas**
- **Information Protection/Information Assurance**
  - **Networked Fires**

Programmed Objective Force Comms Systems



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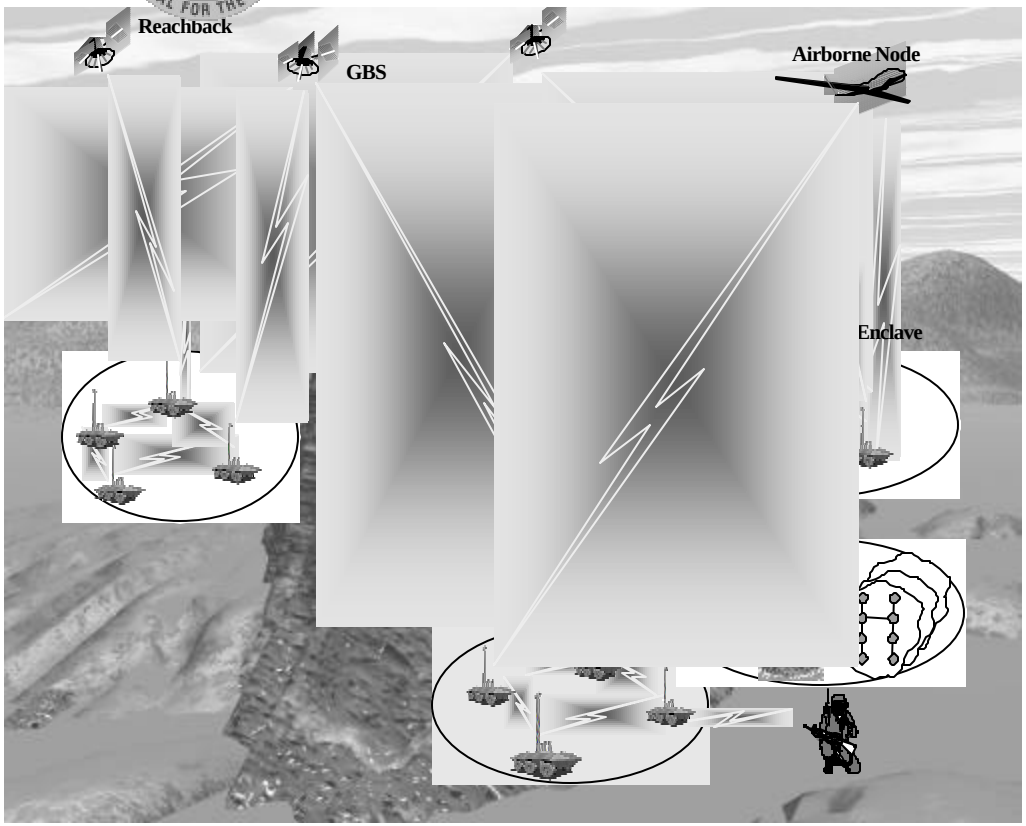
On-the-Move Networking - Mobile Infrastructure



- **Challenge:**
  - Provide an assured, wireless, network that works in diverse, complex terrain
- **Barriers:**
  - **Days** to preplan & configure network
  - Limited bandwidth for assured network access, services, & speed of delivery
  - Complex, dynamic, network mgmt
  - Continuous coverage

MOSAIC ATD

- **Solutions:**
  - **Minutes** to configure network via self-organizing Ad Hoc protocols
  - Efficient bandwidth utilization via adaptive algorithms
  - Simplified automated net ops using intelligent distributed agents
  - UAV Communications payloads

- **Collaboration:**
  - DARPA, Commercial, Other Services, Industry IR&D

Warfighter Payoff: Increased Responsiveness, Deployability, Agility and Versatility

MOSAIC

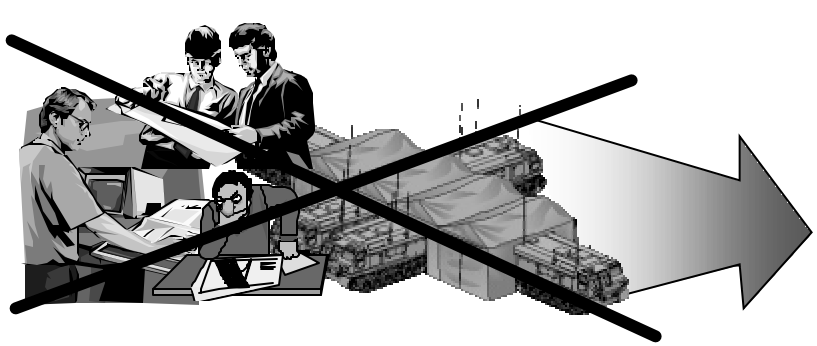
- Multiple Contracts Awarded
- Modular demo in 02
  - 6-10 vehicle & lab platforms
- Integrated demo in 04
  - Relevant environment with Agile Commander ATD

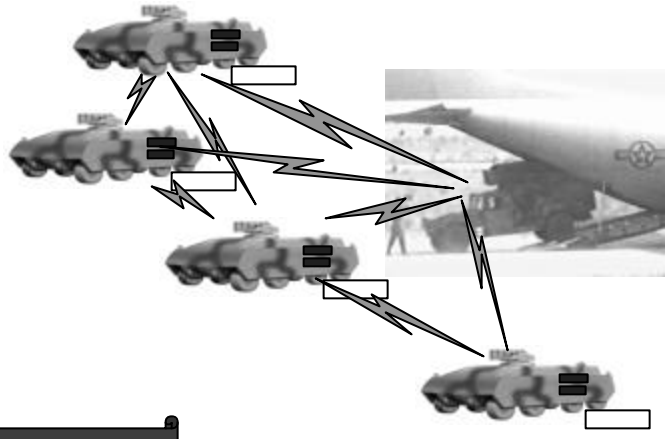
Breadboard Test -TRL 5

- Lab test environment
  - Limited dynamics
  - Simulation for scalability
- Demonstrates Technical approach
- Identifies Integration/ Interface issues

TRL 6

- 15-20 nodes, vehicle & fixed with Surrogate UAV
- Integrated with other STOs





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On-the-Move Tactical SATCOM Technology

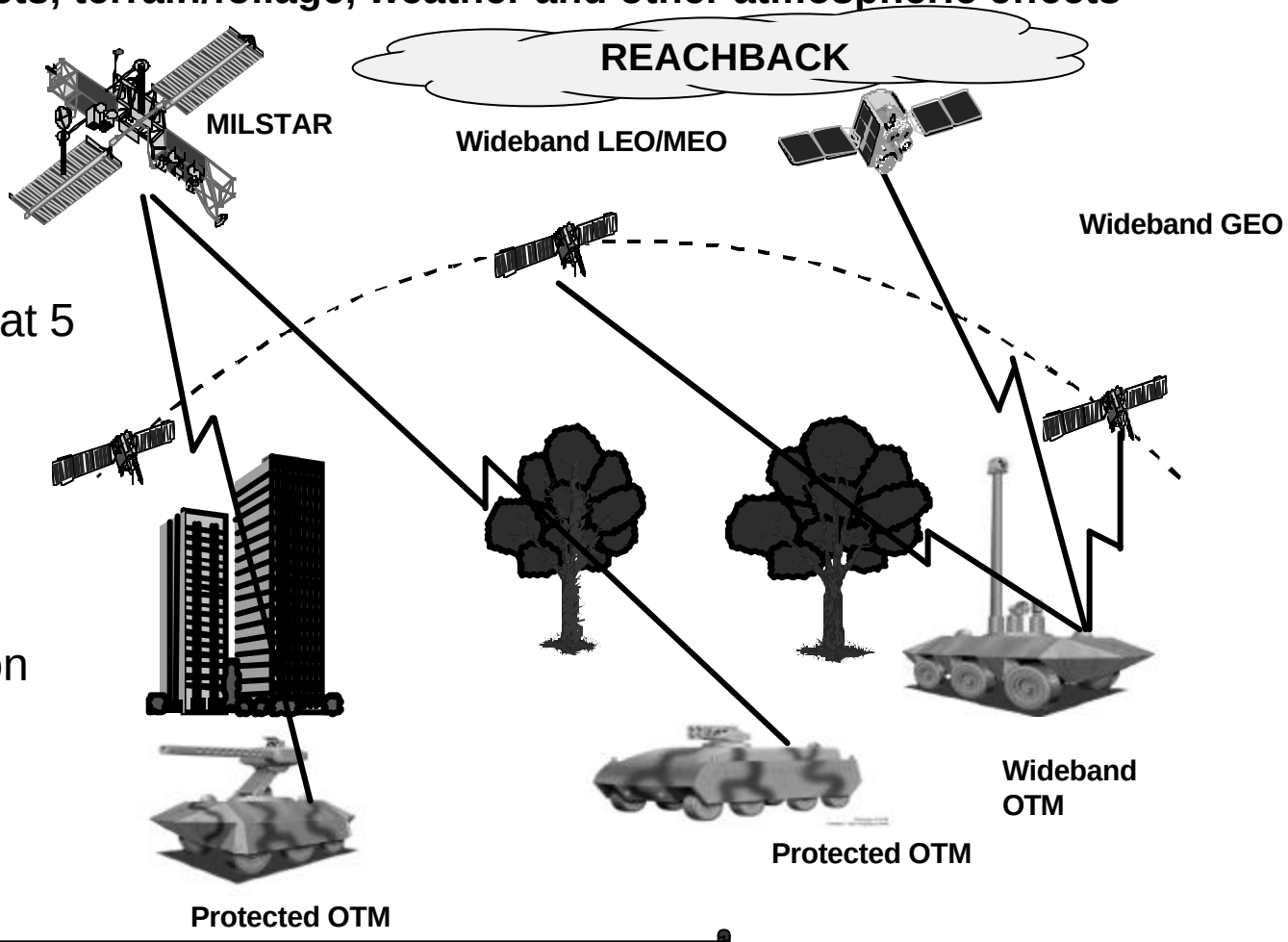
<u>Objective:</u> Enable on-the-move SATCOM for military and emerging commercial satellites which recovers quickly from signal blockages due to man made objects, terrain/foliage, weather and other atmospheric effects

Applications:

- **Scouts:** MILSTAR OTM comms at 9.6 kbps
- **C2 Node to C2 Node:** Wideband OTM comms at 5 Mbps Rx, 256 kbps Tx

Major efforts:

- Blockage mitigation (voice & data)
- Rapid Satellite acquisition and reacquisition
- Turbo Codes
- Integration
- OTM Assessment



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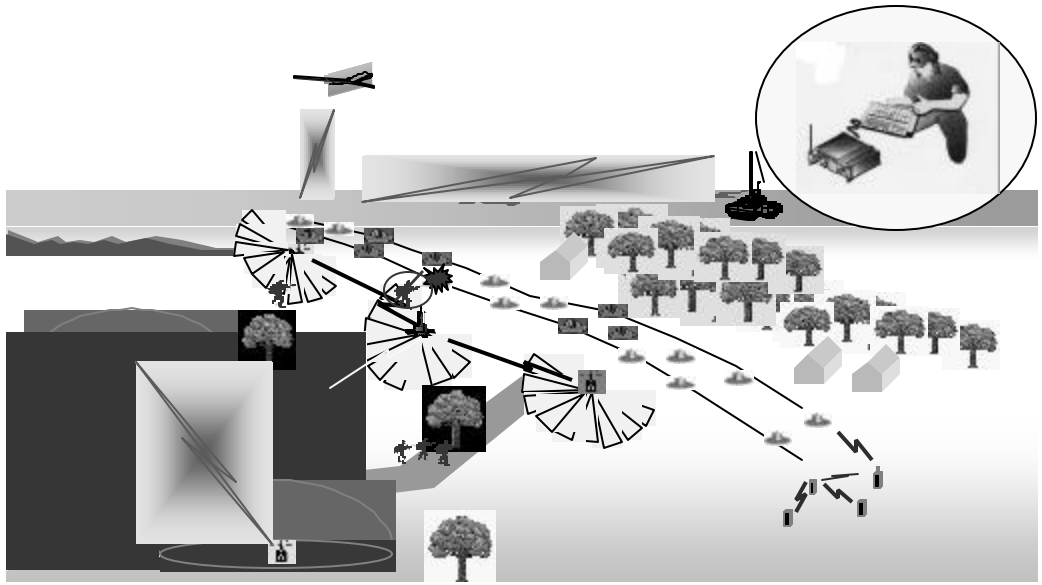
Networked Sensors for the Objective Force Communications

Objective: **Develop a robust secure jam resistant, stealthy communications network for unattended devices**



Pacing Technologies:

- **Low-power, small efficient fast signal correlators**
- **Jam-resistant, LPI/LPD waveforms**
- **Energy-efficient networking protocols and channel access**

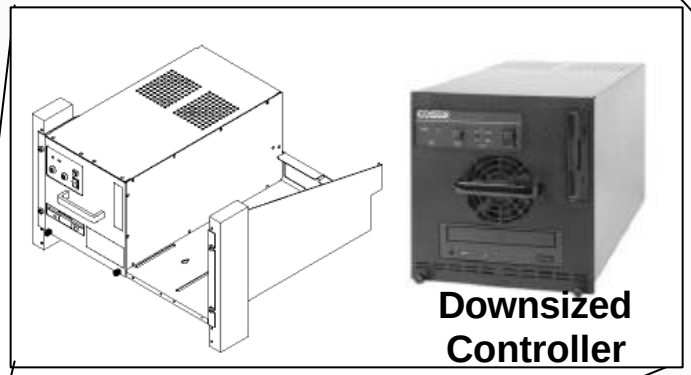
Warfighter Payoffs:

- **Enhanced Survivability**
- **Improved Situational Awareness --- quicker reaction, broader coverage, better identification**

A Secure, Stealthy, Robust, Power Efficient Miniature Radio and Network

Terrestrial PCS (Example)

Commercial Basestation Controller



Downsized Controller

Bridge Switch Node

Downsized Basestation

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Universal Handset Technology

Mobile Satellite System

Terrestrial/ACN Cellular (Multi-band 800/900/1900) and SUO-SAS (200-800)

Bluetooth Air Interface

Netted mode and Group Services

One-Touch Internet Access

Peer-to-peer w/ ad hoc networking - SUO-SAS

Full motion video

MDR/LDR data and extended display ports

Type I - Type IV Security

Super sensitive, rapid acquisition P/Y code GPS

Plus: standard cell phone features such as hands-free operation, voice recognition, and button memory dialing

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Tactical Antenna Technologies

JTRS Multiband On-The-Move (OTM) Antenna

- **JTRS Critical Component**
- **Tactical OTM LOS Scenarios**
  - **Ground, Airborne**
- **30 - 450 MHz**
- **400-2000 MHz**
- **High Power Capability**

Technologies

- **Dual mode VHF/UHF Dipole/Monopole**
- **Distributed Reactive Tuning**
- **Multielement Radiating Structures**
- **Coaxial & slotted traps**
- **Genetic algorithm optimization**
- **Taped resistive loading**
- **Lumped circuit loading**
- **Distributed LRC Networks**

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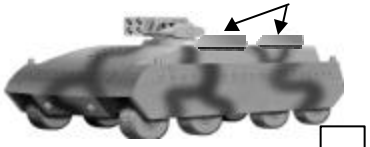
Ferroelectric Phased Array
(Wideband OTM)

TODAY (Static)

RCV / XMT ARRAYS



TOMORROW (Mobile)

- **Challenge**
  - Enable OTM non line-of-sight communications via UAV and SATCOM
- **Barriers**
  - Supporting multiple beams simultaneously
  - Very expensive construction methods
  - Size and complexity
  - Off road tracking stability

Material Breakthrough!

- **Solutions**
  - Revolutionary low profile, wideband, cost effective antennas using Ferroelectric materials
  - Sophisticated tracking algorithms
  - Micro Electro Mechanical Systems (MEMS) integrated with interferometric GPS

High Availability, Wideband, OTM, Beyond Line-of-Sight

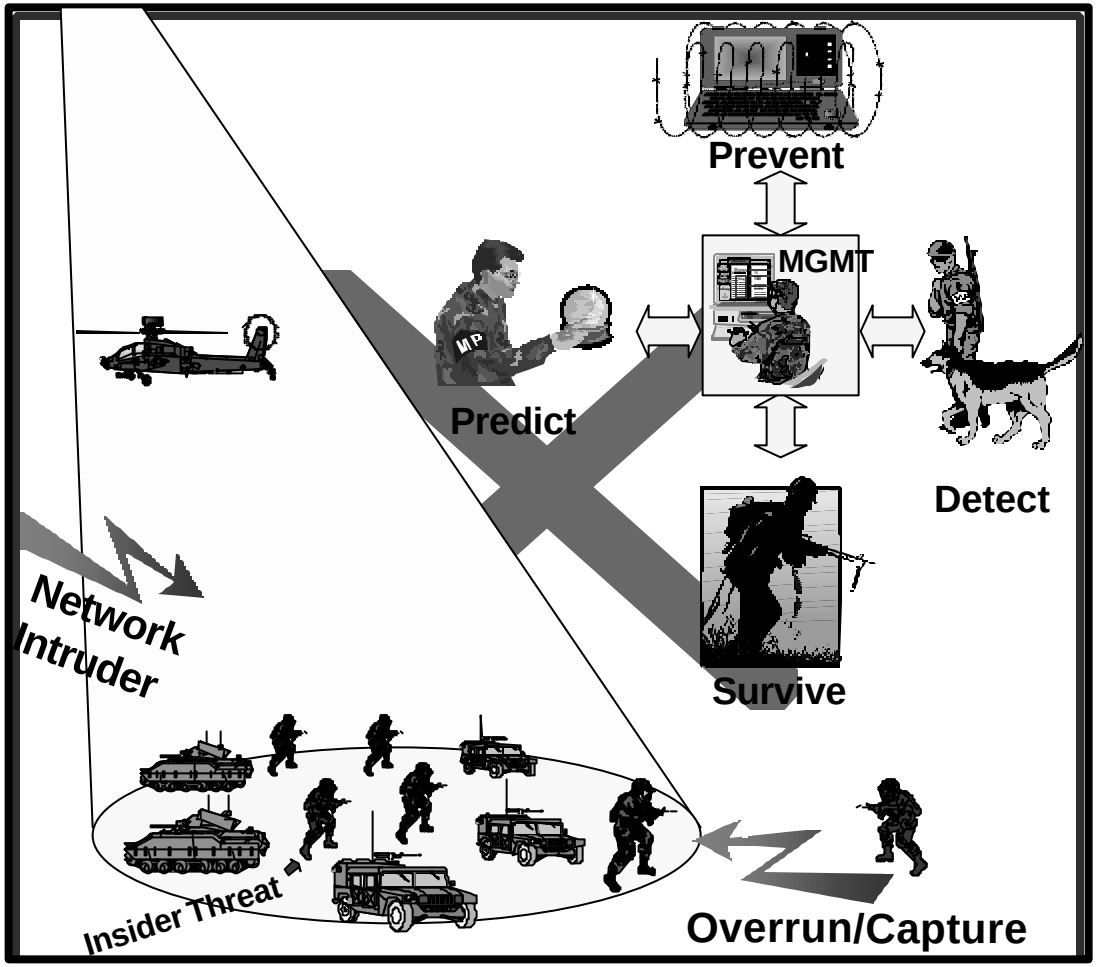
Program Concept Chart
Tactical Information Assurance Technology

(CER-01)

Objective: Adapt and Develop Critical Information Assurance Components to Insure Network Availability Despite Increasing Threats

Total Program $24.3M

OPM $120M



Pacing Technologies:

- Advanced Network Access Control
- Next Generation Intrusion Detection
- Synchronized Security Management
- Tactical Public Key Infrastructure
- Mobile Code Authentication

Warfighter Payoffs:

- Increased Warfighter Confidence to Prosecute Battle
- Reduced Vulnerabilities In Objective Force Networks
- Limit Compromise in Overrun Situation
- Effective Security Management to Avoid Personnel Increase

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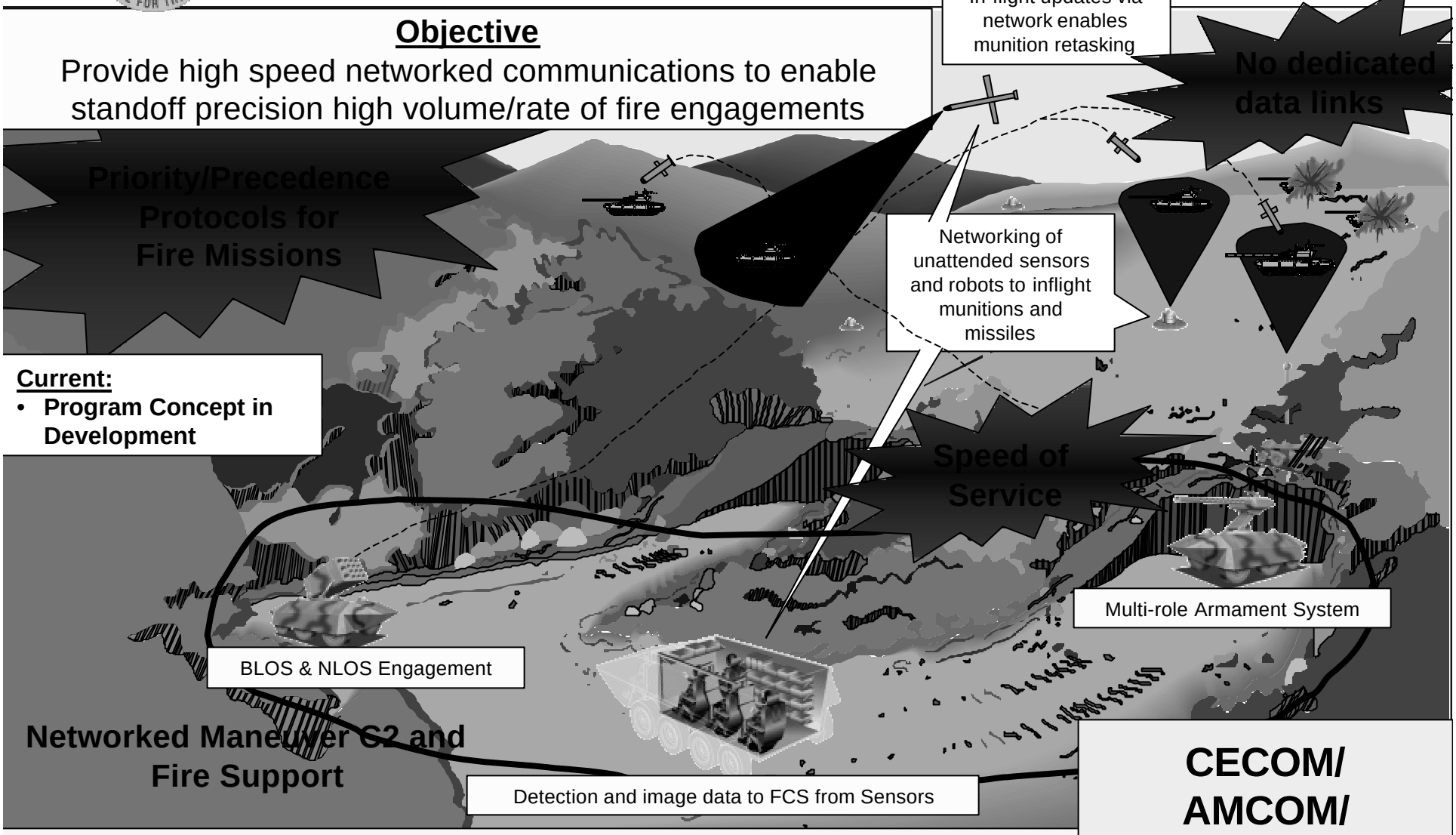
2/27/01

Networked Fires

Objective

Provide high speed networked communications to enable standoff precision high volume/rate of fire engagements



Current:

- **Program Concept in Development**

Enable One Shot One Kill

CECOM/ AMCOM/ ARDEC

It’s a Network Centric World!

Right info...

Right time...

Right warfighter.